

Persistent Sciatic Vein and Coexistent Neuromuscular Variations – a Case Report

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ABSTRACT

Introduction: persistent sciatic vein (PSV) is a variant vein of the thigh seen as a rare congenital anomaly. It remains undiagnosed unless presenting with thrombosis.

Case Report: during routine dissection in a 65-year-old male cadaver, bilateral PSV was identified along with the third head of gastrocnemius on the right side and an additional nerve supplying the short head of biceps femoris muscle on the left. PSV, on both sides, was formed in the popliteal fossa by the union of anterior and posterior tibial veins. It entered the anterior compartment of the thigh by passing below the quadratus femoris muscle on the right side and through an opening in the adductor magnus on the left and drained into the femoral vein. The femoral veins were of normal caliber in both limbs. The total length of PSV on the right and left sides was 41 cm and 37 cm, respectively. On the right side, a third head took origin from the lateral condyle of the femur just above the lateral head of the gastrocnemius and subsequently joined it. In the left gluteal region, the sciatic nerve supplied a branch (length=25cm) to the short head of the biceps femoris apart from the branch from it in the thigh.

Conclusion: the knowledge of PSV is clinically relevant for surgeons in cases of deep vein thrombosis and recurrent varicose veins. The awareness of its coexistence with the third head of the gastrocnemius is likely to aid diagnosis in cases of popliteal vascular entrapment.

Keywords: Persistent sciatic vein; Gastrocnemius; sciatic nerve; Popliteal vein variation.

Introduction

The venous system in the lower limb is of two types deep and superficial system. The superficial veins are the long and short saphenous veins that lie in the subcutaneous tissue, and the deep veins run below the deep fascia and accompany the arteries.¹ Lower limb venous anatomy is highly variable. According to literature, normal venous anatomy is seen only in 17% of patients. The variations are most commonly seen in the femoral vein, followed by those in the popliteal vein.²

Persistent sciatic vein (PSV) is a rare occurrence seen due to inherited venous anomaly.³ Its knowledge is important in interpreting and diagnosing deep vein thrombosis's clinical condition, which leads to postphlebotic syndrome and pulmonary embolism.² PSV is also the cause of rectal bleeding due to high pressure in the deep pelvic vein and recurrent posterior thigh varicose veins. It is commonly associated with Klippel Weber -Trenaunay Syndrome (KTWS).³

The gastrocnemius muscle forms the belly of the calf and is the most superficial muscle of the posterior compartment of the leg. It is a two-headed muscle arising from the medial and lateral condyles of the femur. The muscle inserts into the calcaneum by forming a calcaneal tendon along with the soleus

muscle. It acts as a plantar flexor of the foot and the knee flexor and helps in walking, running, and leaping. The third head of gastrocnemius may arise from the posterior surface of the femur.¹ When crossing the popliteal vessels, this third head can cause popliteal vascular entrapment syndrome.⁴

In the present case report, we discuss the concomitance of bilateral PSV, third head of gastrocnemius muscle on the right side, and an additional nerve supplying the short head of biceps femoris muscle on the left.

Case Report

During routine dissection of a 65-year-old male cadaver, multiple neurovascular and muscle variations were observed. A variant vein, identified as PSV, formed in popliteal fossa by the union of anterior and posterior tibial veins, and here the short saphenous vein drained into it. After its course in the thigh, PSV eventually entered the anterior compartment and drained into the femoral vein. The popliteal vein was the continuation of a tibial vein from the anterior compartment of the leg and all the genicular veins opened into it. In the popliteal fossa, the popliteal vein was anterior (deep) to the popliteal artery, and PSV was posterior (superficial) and lateral to the artery (Fig. 1A,2A). The short venous channels, one on the

right and two on the left, connected the popliteal vein and PSV in the popliteal region.

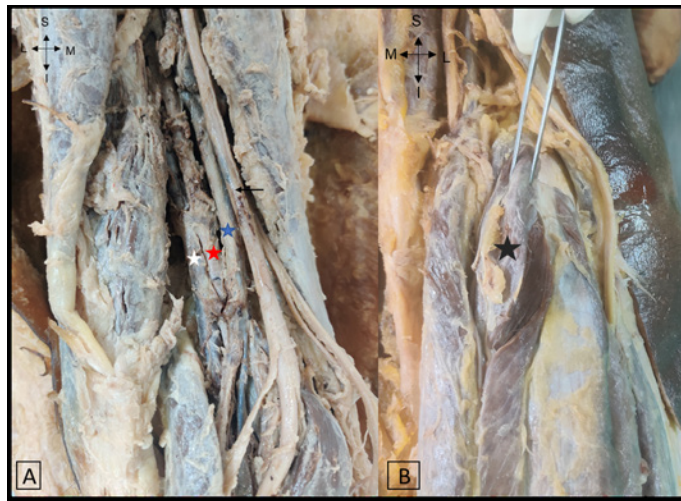


Figure 1. Right popliteal fossa. A) Relation between popliteal vessels, persistent sciatic vein and sciatic nerve. B) Presence of third head of gastrocnemius. Black arrow – Sciatic Nerve; White Star – Popliteal vein; Red Star – Popliteal artery; Blue star – Persistent Sciatic vein; Black Star – Third head of Gastrocnemius.

On the right side, PSV was seen between the medial head of gastrocnemius medially and plantaris with the third head of gastrocnemius laterally. In the popliteal fossa, the vein was anterior (deep) to the sciatic nerve, further passing medial to it, and came to lie lateral to the popliteal artery and medial to biceps femoris (Fig. 1A). It received tributaries from the medial head of gastrocnemius, long head of biceps femoris, and semitendinosus. Further, it coursed below the quadratus femoris muscle to reach the anterior compartment of the thigh. Popliteal vein formed medial to the popliteal artery and entered the adductor hiatus to continue anteriorly as the femoral vein. The total length of PSV was 41 cm. The distance from the lateral margin of the lateral tibial condyle and ischial tuberosity to the position of PSV below the quadratus femoris was 34 cm and 7 cm, respectively. The distance between the saphenofemoral junction and anterior superior iliac spine to the entry of PSV into the femoral vein was 6 cm and 17 cm, respectively. Ipsilaterally, a three-headed gastrocnemius muscle was observed (Fig. 1B). The medial and lateral heads took origin from the respective condyles of the femur, and the third head originated from the lateral condyle just above the lateral head, subsequently joining it. All three heads received separate branches from a tibial nerve in the popliteal fossa.

On the left side, both variant and popliteal veins were seen between the medial head of the gastrocnemius and plantaris muscles. The popliteal vein entered the adductor hiatus to continue as the femoral vein. PSV came to lie between the short head of biceps femoris and sciatic nerve, and anterior (deep) to the long head of biceps femoris, in the posterior aspect of the thigh (Fig. 2A). It finally entered through an opening in the adductor magnus muscle to enter the anterior

compartment (Fig. 2B). The total length of PSV was 37 cm. The distance from the ischial tuberosity and lateral tibial condyle to the opening in adductor Magnus for the PSV was 16 cm and 26 cm, respectively. The distance from the saphenofemoral junction and anterior superior iliac spine to the entry of PSV into the femoral vein was 7 cm and 19 cm, respectively. The two channels connecting the popliteal vein and PSV were 7 cm apart. In the gluteal region, just below the piriformis muscle, the sciatic nerve gave a long branch that ran posterior (superficial) to it (Fig. 2B). In the posterior aspect of the thigh, this nerve ran between sciatic nerve and PSV, and then between PSV and its tributary from the long head of biceps femoris. Subsequently, the nerve was seen between the two heads of the biceps femoris and supplied the short head from its medial aspect. This branch supplying the muscle was in addition to the branch from the sciatic nerve in the thigh. The total length of the variant nerve was 25 cm.

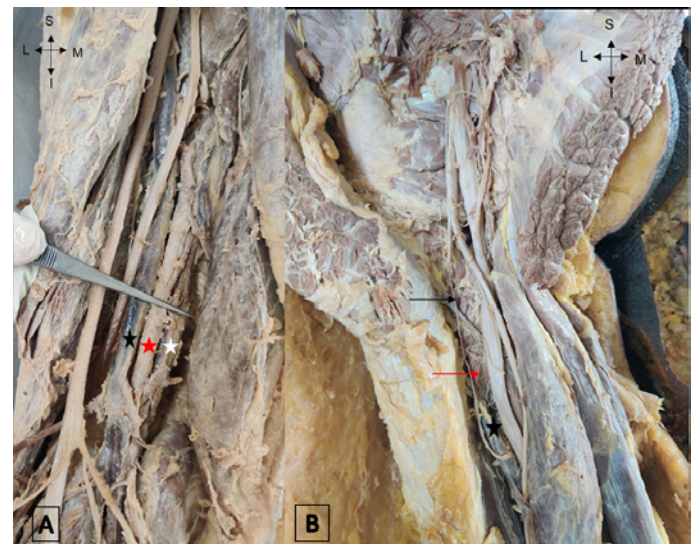


Figure 2. Left lower limb. A) Popliteal fossa showing relation between popliteal vessels and persistent sciatic vein. B) Gluteal region showing the origin of branch (black arrow) to short head of biceps femoris from sciatic nerve and the opening in adductor magnus (red arrow) for persistent sciatic vein in upper thigh. Black Star – Persistent sciatic vein; Red Star- Popliteal artery; White Star – Popliteal vein.

Discussion

The popliteal and femoral veins are the deep venous system accompanying the arteries, and the perforator veins provide communication between superficial and deep veins.⁵ PSV is a rare congenital anomaly,² that may occur due to deviation in the development process in intrauterine life.⁶ It is mostly seen in KWTS. PSV is also a marker for extensive arteriovenous malformation. Cherry *et al.* classified it into three variants – complete, proximal or superior, distal or inferior. In complete type, PSV arises from the popliteal vein or nearby tributaries and passes through the sciatic notch to terminate in the internal iliac vein. Here, PSV is present in the entire length of the thigh and buttock region. In the superior

type, PSV arises from small tributaries or embryonic subcutaneous veins and passing through the sciatic notch to terminate in the pelvis and is present only in the upper thigh and buttock region. The inferior type is present in the distal and middle thigh and ends in the deep femoral vein or embryonic subcutaneous network.⁷ As per the above mentioned classification, PSV in the present case belongs to the inferior type.

Koc *et al.* published a case report that described the venous connection between the popliteal and the variant veins, two on the right side and one on the left side.⁶ In the present case report, similar communicating veins were seen at one level on the right side and two on the left in the popliteal fossa. Cimen *et al.* also reported a bilateral variant vein in popliteal region in a female cadaver. Here, the right variant vein drained into the femoral vein, and left vein drained into the inferior gluteal vein.⁵ Sadowska *et al.* found PSV in three (4.7%) out of 34 bilateral lower limb specimens. Here, all three veins drain into the first perforating vein.² Cherry *et al.* found PSV in 20 (48.8%) patients out of 41 in an MRI study, and all these patients had KTWS.⁷

Embryologically, venous development in the lower limb is determined by three primary angioguiding nerves, axial or sciatic nerve, pre-axial or femoral nerve, and post-axial nerve. VEGF, B2, B4 from the ephrin family secreted from nervous tissue is responsible for artery and venous formation, and differentiation.⁵ During embryogenesis, the sciatic vein is the first to appear as an extension of hypogastric vein. The second venous tract develops following the external iliac artery. The two venous tracts join and form the popliteal vein. Finally, the femoral vein develops following the regression of the sciatic vein into the hypogastric vein. Hypothesis given by Servallo *et al.* states that sciatic vein persists as main out-flow tract when the femoral vein is occluded or fails to develop.³ However, in our report femoral vein of normal caliber was seen along with PSV on both right and left sides.

The gastrocnemius tertius or the third head is the most common variation of gastrocnemius muscle. Kelch first described it in 1813. Phylogenetically, gastrocnemius is the fibular side muscle. It arises from the calcaneum blastomere (5.5 weeks) and ascends to the inferior femoral epiphysis. At seven weeks, the lateral head of gastrocnemius forms a tendinous attachment to the lateral condyle of the femur. At this time, the medial head is still migrating to get attached to the medial condyle of the femur finally. Medial head inserts at a higher level than the lateral head.^{8,9} Third head of the gastrocnemius is due to congenital growth of excess muscle.

The incidence of the third head is 2.9% - 3.4%, with the Japanese population having a frequency of about 5.5%.¹⁰ Third head can arise from linea Aspera, long head of biceps femoris, lateral epicondyle, knee joint capsule, mid fibula, and crural fascia.⁹ We found three heads of the gastrocnemius muscle in the right leg of the cadaver. It originated from the lateral condyle of the femur just above the lateral head attachment. Shalini and Suriyakumari observed three heads of gastrocnemius in four (20%) out of 20 lower limbs, with the third head arising from the lateral condyle with the lateral head.¹¹ Koplak *et al.* identified the third head of gastrocnemius in 21 cases (2%) of 1039 cases using MR imaging. They found the third head to be arising from the midline of the posterior distal femur, between the mid and medial aspect, and joined the lateral head of the gastrocnemius. The muscle morphology was thin thread-like in some cases and bulky in other cases.¹² Dave *et al.* reported the presence of the third head of gastrocnemius on the left lower limb of a cadaver. The extra head was attached to the lateral aspect of the popliteal surface of the femur and joined the junction of medial and lateral heads of the gastrocnemius muscle.⁴

Popliteal vascular entrapment syndrome in popliteal fossa occurs due to numerous muscle variations, more commonly due to the presence of the third head of gastrocnemius muscle.⁹ This syndrome presents more commonly with arterial occlusive changes, and venous symptoms are rarely reported in the literature. The term popliteal vascular entrapment syndrome was initially coined by Rich.¹⁰ Popliteal artery compression due to congenital muscular anomaly was first mentioned by Hamming in 1959, and popliteal vein compression due to the muscular anomaly, known to be rarest, was initially reported by Rich and Huges in 1967, and Edmondson and Crowe in 1972.¹³

The causes of popliteal vascular entrapment syndrome mentioned in literature are passage of artery through the medial head of gastrocnemius muscle, entrapment of vessels by muscle slips or fibrous bands, venous entrapment alone or in combination with artery.¹⁰ The signs and symptoms of vascular entrapment are the history of leg swelling, aching pain, muscle cramp after standing, tenderness in the popliteal fossa, and diminution of an arterial pulse by dorsiflexion of the ankle. Diagnosis can be made using arterial and venous doppler where arterial pulse diminishes or disappears, venous pressure is elevated on dorsiflexion of the ankle. Another diagnostic method is a CT scan of the popliteal region.

The popliteal vascular entrapment syndrome due to the third head of gastrocnemius muscle is treated by partial resection of excess muscle and a postoperative splint for a couple of days.¹⁰

The sciatic nerve supplies the short head of the biceps femoris in the thigh.¹ Sometimes, the sacral plexus gives a direct branch that supplies the short head of the biceps femoris.¹⁴ However, an additional branch from the sciatic nerve has not been mentioned in the literature. We found an additional branch from the sciatic nerve in the gluteal region, supplying a

short head of the biceps femoris muscle.

The knowledge of PSV is clinically relevant for surgeons in cases with deep vein thrombosis and recurrent varicose veins. The awareness of its coexistence with the third head of the gastrocnemius is likely to aid diagnosis in cases of popliteal vascular entrapment. To our knowledge, the coexistence of PSV with these neuromuscular variations has not been reported previously.

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